

To make the exposure, the plate was drawn up until the projecting pin, D, could be caught on the lever, K, which would then retain it. On depressing the outer end of this lever, however, with the finger, the hold on the pin was disengaged, and the plate flashed across the axis of the tube, allowing light to traverse the narrow slit as it flew past. The plate was then arrested on the end of the second lever, G. When an exposure of some seconds was required, as during the totality, a plate having a round orifice exposing the entire field of the eye-piece was substituted for the one with the narrow slit, and was so arranged that, when caught by the upper lever, it covered the lens, but when fallen to the second lever, exposed it entirely; when, however, this lever was in turn touched, the plate descended again far enough once more to close the lens. By touching these two levers in succession, it was then possible to make a "time exposure" with great nicety and accuracy, as proved by actual experience during the eclipse.

To secure a chronographic record of each exposure, a binding screw was provided to make one connection with the general mass of the face-plate including lever K, and another at L, to carry on the circuit when the downward motion of the lever brought the spring at its side in contact with the point projecting from L. In raising the lever for a new exposure, the spring at its side was pressed back so as to pass the point without contact.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.]

Kant's View of Space

THE following paragraphs, I believe, faithfully render sundry passages of Kant's writings:—

"Objects are given to us by means of sense (Sinnlichkeit), which is the sole source of intuitions (Anschauungen); but they are thought by the understanding, from which arise conceptions (Begriffe)." ("Kritik," p. 55. Hartenstein's Edition.)

"The understanding is the faculty of thought. Thought is knowledge by means of conception." (*Ibid.* p. 93.)

"The original consciousness of space is an intuition *à priori*, and not a conception (Begriff)." (*Ibid.* p. 60.)

"Space is nothing else than the form of all the phenomena of the external senses; that is, it is the subjective condition of sense, under which alone external intuition is possible for us." (*Ibid.* p. 61.)

"Our nature is such, that intuition can never be otherwise than sensual (Sinnlich); that is, it only contains the modes in which we are affected by objects. On the other hand, the power of thinking the object of sensual intuition, is the understanding. Neither of these faculties is superior to the other. Without sense, no object would be given us, and without understanding none would be thought. Thoughts without contents are empty, intuitions without conceptions (Begriffe) are blind." (*Ibid.* p. 82.)

"Time and space are 'mere forms of sense'" (Formen unserer Sinnlichkeit, "Prolegomena," p. 33) and "mere forms of intuition." ("Kritik," p. 76.)

With these passages before one, there can be no doubt that that thorough and acute student of Kant, Dr. Ingleby, was perfectly right when he said that Kant would have repudiated the affirmation that "space is a form of thought." For in these sentences, and in many others which might be cited, Kant expressly lays down the doctrine that thought is the work of the understanding, intuition of the sense; and that space, like time, is an intuition. The only "forms of thought" in Kant's sense, are the categories.

T. H. HUXLEY

January 14

I do not believe Professor Sylvester has been betrayed, as Mr. G. H. Lewes asserts, into any misconception of this matter by me.

When Kant, at the outset, says, "Alles Denken aber muss sich, es sei geradezu oder im Umschweife, vermittelst gewisser Merkmale, zuletzt auf Anschauungen...beziehen," it would take the veriest dunderhead not to see that all forms of intuition must be, indirectly at least, forms of thought. I never dreamed of disputing

so obvious a position. But I object to the phrase "forms of thought," as designating Space and Time, on the ground of precision. They are *peculiarly* forms of general Sense, and not forms of Thought as Thought. Kant, I believe, eschewed the phrase in that sense, and, for all I see, might for the same reason have disclaimed it.

Ilford, Jan. 14

C. M. INGLEBY

It is not *my* habit "when objections are made to what I have written, silently to correct my error or silently disregard the criticism." If the objections are well founded, I think it due to the cause of truth to make a frank confession of error, and in the opposite case to reply to the objections.

With reference, then, to Mr. Lewes's strictures in NATURE's last number, I beg to say that Dr. Ingleby has "betrayed" me into no error. If I have fallen into error, it is with my eyes open, and after satisfying myself by study of Kant, that to speak of Space and Time, whether as forms of understanding, or as forms of thought, is an unauthorised and misleading mode of expression. Space and Time are forms of sensitivity or intuition. The categories of Kant (so essentially in this point differing from those of Aristotle) do not contain Space and Time among them, and are properly called forms of understanding or thought.

To the existence of thought the operation of the understanding is a necessary preliminary.

Sensibility and intuition are antecedent to any such operation.

Can Mr. Lewes point to any passage in Kant where Space and Time are designated *forms of thought*? I shall indeed be surprised if he can do so—as much surprised as if Mr. Todhunter or Mr. Routh, in their Mechanical Treatises, were to treat *energy* and *force* as convertible terms. To such a misuse of the word *energy* it would be little to the point to urge that *force without energy is a mere potential tendency*. It is just as little to the point in the matter at issue, for Mr. Lewes to inform the readers of NATURE that *intuition without thought is mere sensuous impression*.

Dr. Ingleby has rendered, in my opinion, a very great service to the English reading public, by drawing attention to so serious and prevalent an error as that of confounding the categories (the proper forms of thought *as thought*) with Space and Time, the forms of intuition, the Sentinels, so to say, who keep watch and ward outside the gates of the Understanding.

Athenæum Club, Jan. 15

J. J. SYLVESTER

Correlation of Colour and Music

SOME twenty-six or twenty-seven years ago, in a lecture on Light at the London Institution, I suggested an analogy between the octaves of Sound and Light; not then knowing the view of Sir J. Herschel to which Dr. Pereira subsequently called my attention.

I endeavoured to support the hypothesis of three primary colours by supposing the intermediate colours to arise from the blending of the primary. Thus orange would result from the blending of red and yellow, green from yellow and blue, and violet from the secondary red impinging on the blue or indigo. This seemed to me a less arbitrary explanation than that of Sir D. Brewster of a superposition (in degrees of intensity chosen to suit the hypothesis) of all the primary colours throughout the whole spectrum. Spectrum analysis has now much changed our views on this subject.

The interesting article in your number for January 13, by Mr. Barrett, has recalled my attention to the matter, and induces me to ask whether he, or any of your contributors, can explain a phenomenon which I have very often observed, as have doubtless others, but which I have never seen noticed in any work on Light.

It is this. When a very brilliant solar-rainbow is seen, there is plainly visible within, and forming a continuous spectrum with the main rainbow, a repetition, but in much narrower bands, of the rainbow: the same seven colours in the same order; and within this again, I have, on certain occasions, detected a third. Are these repetitions of the spectrum as suggested by Sir J. Herschel? If so, we should have two, three, and more reds, and so of the other colours, in which light, producing the impression of the same colour on the retina, would have different wavelengths, say, in the ratios of one, two, four, &c.; or is the phenomenon due to some other cause?

W. R. GROVE

January 15

I VENTURE to call attention to a curious point in connection with the very interesting note by Mr. W. F. Barrett on the "Correlation of Colour and Music," which appeared in yester-

day's NATURE (January 13). The researches of Helmholtz and others have (as is well known) overthrown, to a certain extent, the old idea of the three primary colours—red, blue, and yellow—and have shown that if any *three* are to be selected, red, blue, and green have greater claims than the former. Now, in Mr. Barrett's diagram these correspond to the following notes:—

Red. C.	Yellow. E.	Green. F.	Blue-Indigo. G.
Tonic.	Third.	Sub-dominant.	Dominant.

The old triad, red, yellow, blue, correspond to the common chord; but the new triad, red, green, and blue, to the *tonic, sub-dominant* (or fourth) and *dominant* (or fifth); or, in other words, to the three notes which constitute in music the *fundamental base* of the scale.

F. DE CHAUMONT, M.D.

Army Medical School, Netley, Jan. 14

Government Aid to Science

I CANNOT but feel flattered that my letter on this subject should have been thought so dangerous as to require a leading article in the same number by way of immediate antidote, but I must beg you to allow me to correct one or two errors into which you have fallen as to the views I really hold, and which it seems I failed clearly to express. You say, you "understand Mr. Wallace to mean that the main result of cultivating science is merely the gratification of those directly engaged in the pursuit, and that they who do not take this personal interest in it derive little or no benefit from it."

The first half of this passage does express, though imperfectly, what I believe to be the truth; the latter half expresses the exact opposite of what I have ever thought or intended to write on the subject. The main result of the cultivation of science I hold to be, undoubtedly, the elevation of those who cultivate it to a higher mental and moral standpoint; while the secondary, but not less certain result, is the acquisition of countless physical, social, and intellectual benefits for the whole human race. But if these are the *secondary* and not the *primary* results of cultivating science, it seems to me to be radically unsound in principle, and sure to fail in practice, if by means of any system of State support we seek to find a short cut to these secondary results.

The only logical foundation for advocating the furtherance of scientific discovery by the expenditure of public money, would be the belief that science can be most successfully pursued by those whose chief object is to make practical and valuable discoveries; whereas the whole history of the progress of science seems to me to show that the exact opposite is the case, and that it is only those who in a noble spirit of self-sacrifice give up their time, their means, even their lives, in the eager and loving search after the hidden secrets of Nature, who are rewarded by those great discoveries from which spring a rich harvest of useful applications.

One more point. I do not admit that it is just to tax the community for all the Government institutions you name, but in the short space at my command I could not go into details. I have stated how I think some of these institutions require modification to make them accord with the fundamental principle of just government; and if that principle is a sound one, it is easy to see in what way the others should be dealt with. As an example I may indicate, that a detailed survey, like that of the large-scale Ordnance-maps, being primarily a boon to the landowners of the country, should not be *wholly* paid for by the public.

ALFRED R. WALLACE

Food of Oceanic Animals

I FIND on my return home that Dr. Wallich is vexed at my not having given him the credit of having already answered the question which I ventured to put in the ninth number of NATURE, and that he apparently accuses me of inconsistency as regards my estimate of his observations on deep-sea life. I hasten to assure him that my opinion in that respect has never changed; nor do the extracts which he has given from my reports warrant such an inference.

I certainly overlooked some of his remarks in the "North Atlantic Sea-bed" bearing on my question, in which he says (page 131), it may be asked "under what other conditions than exceptional ones can marine animal life be maintained without the previous manifestation of vegetable life, as must be the case if it exists at extreme depths?" And he answers this inquiry by submitting that "in the majority of the marine Protozoa—as for instance in the Foraminifera, Polycystina, Acanthometræ,

Thalassicollidæ, and Spongidae—the proof of these organisms being endowed with a power to convert inorganic elements for their own nutrition, rests on the indisputable power which they possess of separating carbonate of lime or silica from waters holding these substances in solution." But this does not appear to be a satisfactory answer to the inquiry; because a limpet separates carbonate of lime from sea-water in order to construct its shell, yet it cannot be assumed that this animal (which is well known to be a vegetable-eater) has also the power of converting other inorganic substances for its own nutrition. Among the Protozoa, many, probably all, of the Rhizopods are animal-eaters. With regard to sponges, Dr. Bowerbank says (Mon. I., p. 122) that in the greater number their nutriment "is probably molecules of both animal and vegetable bodies, either living or derived from decomposition," and that "the fecal matters exhibit all the characteristics of having undergone a complete digestion."

J. GWYN JEFFREYS

P.S.—In the 10th number of NATURE, Dr. Martin Duncan, under the head of "Deep-Sea Corals," opposes a statement in what he calls a postscript to my report on the "Deep-Sea Dredging Expedition in H.M.S. *Porcupine*." This statement was not part of my report, nor had I anything to do with it.

J. G. J.

MY attention has been directed to a paragraph in one of the late numbers of NATURE referring to Professor Dickie's interesting remarks on the bathymetrical distribution of Algae, and raising the question of the mode of nutrition of the great sheet of animal life, which is now shown to extend over the bottom of the sea at all depths.

This curious problem was of course one of the first which engaged our interest when working up the results of the dredging cruise of the *Lightning*. In April last, I proposed a solution in one of the "Afternoon Scientific Lectures" in connection with the Royal Dublin Society, which was afterwards reprinted in full in the "Annals and Magazine of Natural History." I see from notices in several newspapers that this question has excited considerable interest; I may, perhaps, therefore be allowed to quote the passage in the lecture specially bearing upon it:—

"The question of the mode of nutrition of animals at these great depths is a very singular one. The practical distinction between plants and animals is, that plants prepare the food of animals by decomposing certain inorganic substances which animals cannot use as food, and recombining their elements into organic compounds upon which animals can feed. This process is, however, constantly effected under the influence of light. There is little or no light in the depths, and naturally there are no plants: but the bottom of the sea is a mass of animal life. On what do these animals feed? The answer seems to be sufficiently simple: nearly all the animals—practically *all* the animals, for the small number of higher forms feed upon these—belong to one sub-kingdom, the Protozoa, whose distinctive character is that they have no special organs of nutrition, but that they absorb nourishment through the whole surface of their jelly-like bodies. Most of these animals secrete exquisitely-formed skeletons, sometimes of lime, sometimes of silica. There is no doubt that they extract both of these substances from the sea-water, although silica often exists there in quantities so small as to elude detection by chemical tests. All sea-water contains a certain proportion of organic matter in solution. Its sources are obvious. All rivers contain a large quantity: every shore is surrounded by a fringe which averages about a mile in width of olive and red sea-weeds: in the middle of the Atlantic there is a marine meadow, the Sargasso Sea, extending over three millions of square miles: the sea is full of animals which are constantly dying and decaying; and the water of the Gulf Stream, especially, courses round coasts where the supply of organic matter is enormous. It is, therefore, quite intelligible that a world of animals should live in these dark abysses, but it is a necessary condition that they should chiefly belong to a class capable of being supported by absorption, through the surface, of matter in solution; developing but little heat, and incurring a very small amount of waste by any manifestation of vital activity. According to this view, it seems highly probable that at all periods of the earth's history, some form of the Protozoa, rhizopods, sponges, or both, predominated greatly over all other forms of animal life in the depths of the warmer regions of the sea; whether spreading, compact, and reef-like, as the Laurentian and Palæozoic *ozoön*;